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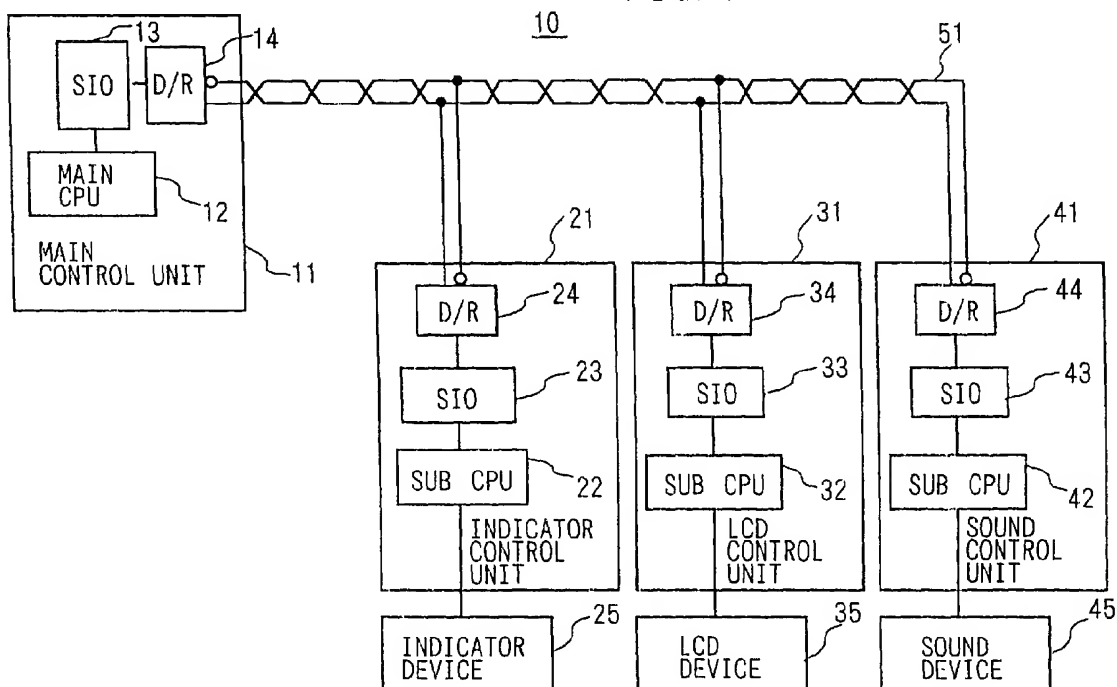
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(54) **"Control apparatus for game machine"**

(57) A control apparatus for a game machine (10), which comprises at least a main control unit (12) and a plurality of sub-control units (22, 25, 32, 35, 42 and 45), comprises a serial communication line (51) for linking the main control unit (12) and the sub-control units (22,

25, 32, 35, 42 and 45) with each other therethrough. The control apparatus allows the game machine (10) to be easily manufactured, tested and maintained at a low cost and improved in its reliability even when the game machine (10) is required to perform a highly enhanced function and have a complicated configuration.

FIG. 1



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a control apparatus for a game machine, and more particularly, to a control apparatus for a game machine having at least a main control unit for performing a main game process, and a plurality of sub-control units for performing subsidiary game functions, comprising a serial communication line by way of which the main control unit is operatively connected with the sub-control units, thereby making it possible to effect transmission of signals between the main control unit and the sub-control units to have the sub-control units carry out the subsidiary game functions, respectively, based on the signals of the main control unit transmitted to the sub-control units.

2. Description of the Related Art

[0002] There have so far been provided with a wide variety of game machines exemplified by a slot machine and a ball shooting game machine including a pachicom game machine, pachinko game machine and the like. Such a game machine comprises at least a main control unit which is constructed of a main board equipped with a main CPU (Central Processing Unit), and a plurality of sub-control units each constructed of peripheral board which is equipped with a sub-CPU. Each of the sub-control units is operatively connected with the main control unit through parallel signal transmission lines, so that the main control unit can control the sub-control units. The main CPU of the main control unit is adapted to execute a main game program to control the winning probability of the game and the decisions of the winning or losing games and to instruct the sub-control units to carry out subsidiary game functions, respectively. The sub-control units are electrically connected to plurality of peripheral devices, such as an indicator, a LCD (Liquid Crystal Display) device and a sound device, respectively. The sub-CPU's of the sub-control units are adapted to execute game sub-programs to carry out the subsidiary game functions to operate the peripheral devices, respectively, in accordance with the instruction transmitted from the main control unit through the parallel signal transmission lines.

[0003] The main CPU of the main control unit is operable to transmit signals including a command to the sub-control units through the parallel signal transmission lines, in such a manner that the sub-CPU's of the sub-control units can be operated to have the sub-control units perform the subsidiary game functions in response to the received command. For example, the sub-control unit which is electrically connected to the indicator can operate the indicator having various lamps and LEDs (Light Emitting Diodes) arranged on a front panel of the

game machine to be turned on and off, while the sub-control unit which is electrically connected to the sound device can operate the sound device, such as a speaker, to output an effective sound and music therethrough.

5 These sub-control units of the game machine thus constructed can provide an enjoyable environment to a player according to the game situation.

[0004] Generally, a relatively large number of parallel signal transmission lines, for example, 12 to 20 signal transmission lines, per only one sub-control unit are needed in the event that such the parallel signal transmission lines are used to connect the main control unit and the sub-control unit. This means that there are prepared a huge number of parallel signal transmission lines for the number of sub-control units for connection between the main and sub-control units to have the total number of parallel signal transmission lines even more increased. Even further in the recent years, there have been emerged various types of game machines which can perform with image and animation displayed on the LCD panel screen and with lights turned off and on in response to the movement of the lighting positions of LEDs. The number of such peripheral devices in the game machines tends to be on the increase. Moreover, many kinds of effective sounds as well as many numbers of music available for the game machine in addition to combinations of these kinds of sound and music and other enhanced multi-functions are on the road to be realized. In response to the enhanced multi-functions, the number of the parallel signal transmission lines tends to be on the rise for transmitting data and commands between the main and sub-control units.

[0005] Such the tendency cannot bring about inconvenient situations to the game machines. This is because that there are many kinds of regulations enforced regarding hardware and software of the game machines.

[0006] As is well known, such game machines should be examined by a special authoritative examining organ to meet various regulated standards whenever the game machines are newly developed or modified along with the specifications requested by game lovers. Even when the game machine has no need to be examined by such the authoritative examining organ, the software and hardware of the game machine should be debugged and inspected by the developer.

[0007] For this reason, newly developed and modified technologies for the game machine should be minutely checked by the authoritative examining organ to clear various kinds of regulations enforced. The examination conducted by the organ is directed to operations and motions of the main and sub-control units. If such the examination includes increased operational items for the main and sub-control units, thereby bringing the number of the signal transmission lines increased, new measures must be taken in cope with the increased signal transmission lines by increasing the number of channels of the analyzer required for checking the game ma-

chines. As a result, inspecting equipment is made to be large in size and at high cost as well as laborious in work.

[0008] Furthermore, the complicated structure of the game machine requires taking a great deal of time to manufacture the game machine in the process of wiring between the main and sub-control units of the game machine. Moreover, the game machine having a lot of main and sub-control units should have corresponding input/output ports respectively assigned to addresses. This is also laborious in work and makes it unreliability.

SUMMARY OF THE INVENTION

[0009] In view of the foregoing problems, it is an object of the present invention to provide a control apparatus for a game machine which can be easily manufactured, tested and maintained at a low cost and improved in its reliability.

[0010] In accordance with an aspect of the present invention, there is provided a control apparatus for a game machine. The game machine comprises at least a main control unit for performing a predetermined main game process, and a plurality of sub-control units respectively operable to carry out predetermined subsidiary game functions. The control apparatus comprises serially communicating means for linking the main control unit of the game machine with the sub-control units of the game machine to have the main control unit serially communicated with the sub-control units of the game machine. The main control unit of the game machine may be operated to transmit an instruction to the sub-control units of the game machine, while the sub-control units of the game machine may be operated to carry out the respective subsidiary game function in accordance with the instruction transmitted from the main control unit of the game machine through the serially communicating means.

[0011] In the aforesaid control apparatus, the serially communicating means comprises a plurality of serial input/output interface units. One of the serial input/output interface units is electrically connected to the main control unit of the game machine, and the other serial input/output interface units are electrically connected to the sub-control units of the game machine, respectively. The serial input/output interface units are electrically connected with each other through a serial communication line.

[0012] In the aforesaid control apparatus, the main control unit of the game machine is constructed of a main board equipped with the serial input/output interface unit, while the sub-control units of the game machine are constructed of peripheral boards each equipped with the serial input/output interface unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present invention and many of the advantages thereof will be better understood from the follow-

ing detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a block diagram showing a preferred embodiment of a control apparatus for a game machine according to the present invention; and FIG. 2 is a block diagram showing the control apparatus electrically connected to an analyzer for analyzing the game machine shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] Throughout the following detailed description, similar reference characters and numbers refer to similar elements in all figures of the drawings.

[0015] Referring now to FIG. 1 of the drawings, there is shown a preferred embodiment of the control apparatus for a game machine 10 according to the present invention. In this embodiment, the game machine 10 is a slot machine.

[0016] The game machine 10 comprises a main control unit 11, three of sub-control units including an indicator control unit 21, a LCD control unit 31 and a sound control unit 41, and three of peripheral devices including an indicator device 25, a LCD device 35 and a sound device 45, as shown in FIG. 1.

[0017] The main control unit 11 is designed to perform a predetermined main game process having the steps of: determining a probability of winning the prize; evaluating the game results; calculating an account on the basis of the game results and so on. The sub-control units 21, 31 and 41 are electrically connected to the peripheral devices 25, 35 and 45, respectively. The sub-control units 21, 31 and 41 are adapted to carry out subsidiary game functions to operate the peripheral devices 25, 35 or 45, respectively, as described below.

[0018] The indicator device 25 has lamps and LEDs for indicating game situation arranged on a front panel of the game machine, not shown in the drawings. The indicator control unit 21 is electrically connected to the indicator device 25 and is adapted to operate the indicator device 25 to turn on and off the lamps and LEDs of the indicator device 25.

[0019] The LCD device 35 has a LCD panel screen, not shown, and is adapted to display an image and project animation on the LCD panel screen. The LCD control unit 31 is electrically connected to the LCD device 35 and is adapted to operate the LCD device 35 to display the image and project animation on the LCD panel screen.

[0020] The sound device 45 has a speaker, not shown, and is designed to produce and output a sound and music through the speaker. The sound control unit 41 is electrically connected to the sound device 45 and is adapted to operate the sound device 45 to produce and output the sound and music through the speaker according to the game situation.

[0021] In the aforesaid game machine, the control apparatus according to the present invention comprises a serial communication line 51 through which the main control unit 11 is linked with the sub-control units 21, 31 and 41. Therefore, the main control unit 11 is adaptable to control the sub-control units 21, 31 and 41 through the serial communication line 51.

[0022] The main control unit 11 comprises a main CPU 12, while the sub-control units 21, 31 and 41 comprise sub-CPU's 22, 32 and 42, respectively. The main CPU 12 of the main control unit 11 is designed to perform the aforesaid predetermined main game process and transmit an instruction to the sub-control units 21, 31 and 41. The sub-CPU 22 of the indicator control unit 21 is designed to receive the instruction from the main CPU 12 of the main control unit 11 to carry out the predetermined subsidiary game function to instruct the indicator device 25 to turn on and off its lamps and LEDs according to the instruction of the main CPU 12 of the main control unit 11. The sub-CPU 32 of the LCD control unit 31 is adapted to receive the instruction from the main CPU 12 of the main control unit 11 to carry out the predetermined subsidiary game function to instruct the LCD device 35 to display an image and project animation on the LCD panel screen according to the instruction of the main CPU 12 of the main control unit 11. The sub-CPU 42 of the sound control unit 41 is adapted to receive the instruction from the main CPU 12 of the main control unit 11 to carry out the predetermined subsidiary game function to instruct the sound device 45 to output a sound and music through the speaker according to the instruction of the main CPU 12 of the main control unit 11.

[0023] In this embodiment, the CPU's 12, 22, 32 and 42 are a "280" type of CPU which is developed by ZiLOG, Inc. The type of CPU may be the other types of CPU such as "LE8080A" which is developed by L. E. TEC, Co., Ltd. in Japan, and so forth.

[0024] The main control unit 11 further comprises a serial input/output port referred to as "SIO" in the drawings and represented by the reference numeral "13", and a driver/receiver referred to as "D/R" in the drawings and represented by the reference numeral "14". In this embodiment, the type of the serial input/output port 13 is "Z80SIO" that may correspond to the type of CPU of the main control unit 11. The driver/receiver 14 may be conformed to a serial interface such as, but not limited to, RS-485 interface.

[0025] The serial input/output port 13 is electrically connected to the main CPU 12 and the driver/receiver 14. The driver/receiver 14 is electrically connected to the sub-control units 21, 31 and 41 through the serial communication line 51.

[0026] The serial input/output port 13 and the driver/receiver 14 thus constructed can cooperate with each other to serially transmit a signal between the main CPU 12 and the other sub-control units through the serial communication line 51.

[0027] Likewise, the indicator control unit 21 further comprises a serial input/output port 23 and a driver/receiver 24. The LCD control unit 31 further comprises a serial input/output port 33 and a driver/receiver 34. The sound control unit 41 further comprises a serial input/output port 43 and a driver/receiver 44. In this embodiment, the type of the serial input/output ports 23, 33 and 43 are "Z80SIO" that may correspond to the type of CPU of the sub-control units 21, 31 and 41, respectively. The driver/receivers 24, 34 and 44 may be conformed to a serial interface such as, but not limited to, RS-485 interface.

[0028] As shown in FIG. 1, the drivers/receivers 14, 24, 34 and 44 are electrically to each other through the serial communication line 51. The main CPU 12 of the main control unit 11 is electrically connected to the sub CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 through the serial input/output ports 13, 23, 33 and 43 and the driver/receivers 14, 24, 34 and 44, respectively, by way of the serial communication line 51. The serial input/output ports 23, 33 and 43, the driver/receivers 24, 34 and 44 and the serial communication line 51 thus constructed can serve as serially communicating means. In the control apparatus thus constructed, the main CPU 12 of the main control unit 11 can serially communicate with the sub CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 through the serially communicating means.

[0029] In this embodiment, the serial communication line 51 is constructed of twisted pair wire for coupling the driver/receiver 14 with the drivers/receivers 24, 34 and 44, so that the control apparatus can establish a serial, bi-directional communication between the main CPU 12 and the sub-CPU's 22, 32 and 42. Although the control apparatus in this embodiment is the serial bi-directional communication, the control apparatus may be a serial one-directional serial communication, which may be preferably conformed to RS-422 interface. The control apparatus may employ any protocols for this communication.

[0030] The drivers/receivers 24, 34 and 44 of the sub-control units 21, 31 and 41 may be preferably arranged in parallel relationship with respect to the driver/receiver 14 of the main control unit 11 as shown in FIG. 1.

[0031] As described above, the main CPU 12 of the main control unit 11 is operated to instruct the sub-control units 21, 31 and 41 to respectively control the peripheral devices 25, 35 and 45 as the need arises during effecting the main game process.

[0032] More specifically, the main CPU 12 of the main control unit 11 is operable to send various commands to the sub-CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 through the serial communication line 51 to operate the peripheral devices 25, 35 and 45. When the sub-CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 are operated to receive the command from the main CPU 12, the sub-control units 21, 31 and 41 are operated to carry out the subsidiary game functions

according to the command to operate the peripheral devices 25, 35 and 45, respectively.

[0033] The sub-CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 are further operable to send various responses to the main CPU 12 of the main control unit 11 through the serial communication line 51. The main CPU 12 of the main control unit 11 is also operated to receive the responses from the sub-CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 through the serial communication line 51.

[0034] The operation of the control apparatus according to the present invention will be described in detail hereinafter.

[0035] The main control unit 11 is operated to send a command to the sub-control units 21, 31 and 41 according to the game situation. The sub-control units 21, 31 and 41 are then operated to receive the command from the main control unit 11 to instruct the respective peripheral devices 25, 35 and 45 to carry out the respective predetermined subsidiary game functions.

[0036] The command is included in a serial signal to be transmitted from the main control unit 11 on the serial communication line 51. The serial signal includes a receiver ID to which the serial signal is transmitted, a sender ID from which the serial signal is transmitted, and data having a command to the sub-CPU's 22, 32 and 42. When the main CPU 12 of the main control unit 11 is operated to send the serial signal to the sub-CPU 42 of the sound control unit 41, the receiver ID indicates the sub-CPU 42 while the sender ID indicates the main CPU 12.

[0037] When the serial signal is transmitted on the serial communication line 51, the serial signal is received by the sub-CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 by way of the serial communication line 51. Each of the sub-CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 is operated to distinguish the receiver ID and the sender ID from the transmitted serial signal. Each of the sub-CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 is operated to judge whether the receiver ID shows itself ID or not and to further judge whether the sender ID shows the ID of the main CPU 12 or not. The sub-CPU corresponding to the receiver ID is operated to accept the serial signal. Then the sub-CPU is operated to carry out the predetermined subsidiary function in accordance with the accepted command.

[0038] For instance, the receiver ID is the sub-CPU 32 of the LCD control unit 31, and the command is an animation producing command. The sub-CPU 32 of the LCD control unit 31 is operated to receive the serial signal to determine that the serial signal includes its ID. The sub-CPU 32 of the LCD control unit 31 is operated to produce and project animation on its LCD panel screen in response to the animation producing command received from the main CPU 12 of the main control unit 11.

[0039] On the other hand, the sub-CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 are operated

to return a response to the main CPU 12 of the main control unit 11. The response may include a positive acknowledge (ACK), error or the like. The response is included in a serial signal to be transmitted from the sub-CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 to the main control unit 11 on the serial communication line 51. In this case, the serial signal also includes a receiver ID to which the serial signal is transmitted and a sender ID from which the serial signal is transmitted in addition to data having the response.

[0040] When one of the sub-CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 is operated to transmit the serial signal to the main CPU 12 on the serial communication line 51, the main CPU 12 of the main control unit 11 is operated to receive the serial signal through the driver/receiver 14 and the serial input/output port 13. The main CPU 12 is operated to select the receiver ID from the received serial signal. The main CPU 12 is operated to judge whether the receiver ID indicates itself or not. When the receiver ID indicates itself, the main CPU 12 of the main control unit 11 is operated to accept the serial signal. The main CPU 12 of the main control unit 11 is further operated to select the sender ID and the data including the response from the accepted serial signal. The main CPU 12 of the main control unit 11 is operated to process a predetermined operation in accordance with the response.

[0041] The control apparatus thus constructed can establish the serial communication between the main CPU 12 of the main control unit 11 and the sub-CPU's 22, 32 and 42 of the sub-control units 21, 31 and 41 in the game machine 10.

[0042] The game machine can be easily manufactured, tested and maintained at a low cost and improved in its reliability, because the control apparatus for the game machine can considerably reduce the number of lines between the main control unit and the sub-control units.

[0043] Referring to FIG. 2 of the drawings, there is shown an analyzing system for game machine shown in FIG. 1 in the control apparatus according to the present invention.

[0044] As shown in FIG. 2, the analyzing system comprises an analyzer 61 such as a protocol analyzer and a monitor unit 62 through which the analyzer 61 is electrically connected to the game machine 10. The monitor unit 62 intervenes between the driver/receiver 14 of the main control unit 11 and the drivers/receivers 24, 34 and 44 of the sub-control units 21, 31 and 41 and adapted to allow the analyzer 61 to monitor the serial communication line 51 between the main control unit 11 and the sub-control units 21, 31 and 41. The monitor unit 62 maybe omitted from the analyzing system. In this case, the analyzer 61 may be directly electrically connected to the driver/receiver 14.

[0045] It will be appreciated from the forgoing description that the control apparatus according to the present invention can be remarkably simplified in comparison

with the prior art when the analyzer 61 is operated to monitor the game machine 10. Therefore, the game machine 10 can be easily tested and maintained at a low cost. This leads to the fact that the reliability of the game machine 10 can be improved. Furthermore, the control apparatus according to the present invention can flexibly fulfill the higher function of the game machine and establish the more complicated structure of the game machine.

[0046] As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

Claims

1. A control apparatus for a game machine (10), said game machine (10) comprising: at least a main control unit (12) for performing a predetermined main game process; and a plurality of sub-control units (22, 25, 32, 35, 42 and 45) respectively operable to carry out predetermined subsidiary game functions,

in which said control apparatus comprising serially communicating means (13, 14, 23, 24, 33, 34, 43, 44 and 51) for linking said main control unit (12) of said game machine (10) with said sub-control units (22, 25, 32, 35, 42 and 45) of said game machine (10) to have said main control unit (12) serially communicated with said sub-control units (22, 25, 32, 35, 42 and 45) of said game machine (10),
 said main control unit (12) of said game machine (10) being operated to transmit an instruction to said sub-control units (22, 25, 32, 35, 42 and 45) of said game machine (10), and said sub-control units (22, 25, 32, 35, 42 and 45) of said game machine (10) being operated to carry out said respective subsidiary game function in accordance with the instruction transmitted from said main control unit (12) of said game machine (10) through said serially communicating means (13, 14, 23, 24, 33, 34, 43, 44 and 51).

2. The control apparatus as set forth in claim 1, in which said serially communicating means comprises a plurality of serial input/output interface units (13, 14, 23, 24, 33, 34, 43 and 44), one of said serial input/output interface units (13 and 14) electrically connected to said main control unit (12) of said game machine (10), and the other serial input/output interface units (23, 24, 33, 34, 43 and 44) electrically connected to said sub-control units (22, 25, 32, 35, 42 and 45) of said game machine (10), re-

spectively,

said serial input/output interface units (13, 14, 23, 24, 33, 34, 43 and 44) electrically connected with each other through a serial communication line (51).

3. The control apparatus as set forth in claim 2, in which said main control unit (12) of said game machine (10) is constructed of a main board equipped with said serial input/output interface unit (13 and 14), while said sub-control units (22, 25, 32, 35, 42 and 45) of said game machine (10) are constructed of peripheral boards each equipped with said serial input/output interface unit (23, 24, 33, 34, 43 and 44).

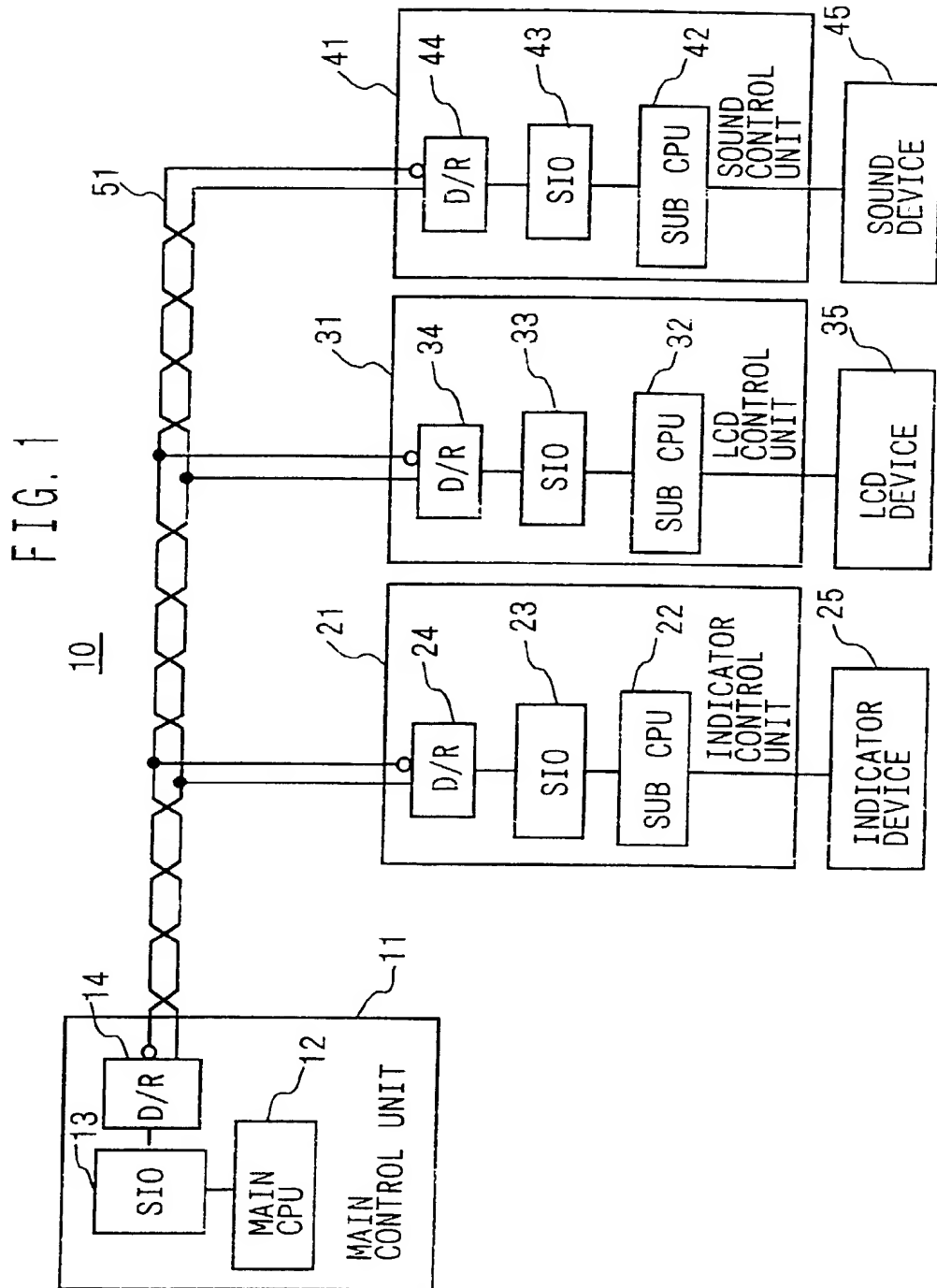


FIG. 2

